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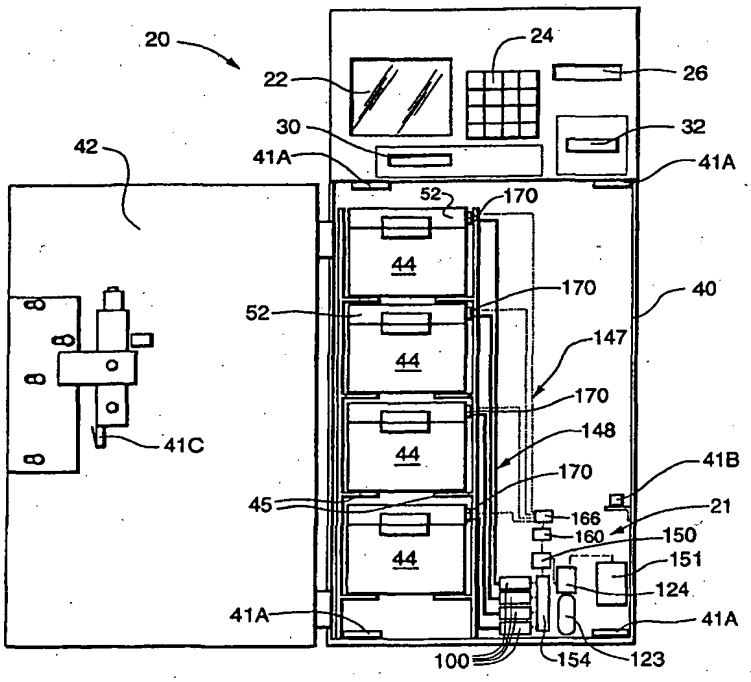
(54) Title: AUTOMATIC TELLER MACHINE ANTI-THEFT SYSTEM, METHOD FOR INSTALLATION THEREOF, AND METHOD FOR PREVENTING AUTOMATIC TELLER MACHINE THEFT

(57) Abstract

An anti-theft system (21) adapted to detect attempted theft from an Automatic Teller Machine (ATM) (20) and to deface currency (46) housed within currency cassettes (44) in response to such attempt. The anti-theft system comprises at least one theft-detection sensor (41A, 41B) capable of activating a trigger signal (149), a source of pressurized gas (125) releasable in response to the trigger signal, and a reservoir (100) containing currency-defacing liquid (103) and connected to the pressurized gas source (123). The reservoir is adapted to release the liquid into a first liquid distribution system (148) upon the reservoir reaching a set pressure. A spray manifold (54) located within the currency cassette and connected to a second liquid distribution system (55) is adapted to forcibly discharge and distribute the liquid upon the currency. The first and second liquid distribution systems are coupled with a coupling device, which may be an automatic coupling device (170) adapted to connect the liquid distribution systems to one another automatically. Methods for preventing ATM theft and for retrofitting a pre-existing ATM with the system disclosed herein, as well as an ATM comprising such an anti-theft system, are also disclosed.



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TITLE

AUTOMATIC TELLER MACHINE ANTI-THEFT SYSTEM, METHOD FOR INSTALLATION THEREOF, AND METHOD FOR PREVENTING AUTOMATIC TELLER MACHINE THEFT

TECHNICAL FIELD

This invention relates to prevention of theft from automatic teller machines (ATMs), and more particularly to a system and method for spraying the currency in the ATM with a defacing liquid upon detection of attempted theft as well as a method of retrofitting a pre-existing ATM with such a system.

BACKGROUND OF THE INVENTION

Automatic Teller Machines (ATMs) have become ubiquitous in today's society, being now located not only at nearly every bank, but also in convenience stores, malls, outdoor plazas, airports, bus terminals, and the like. The widespread use of ATMs has also encouraged increased attempts at theft. Particularly vulnerable to theft are the portable, stand-alone ATM units that can be quickly lifted in their entirety into a truck and taken to a remote location for dismantling and plundering at a felon's leisure.

Various types of ATM anti-theft devices are known in the art, including some that rely on discouraging theft by destroying the currency located inside the ATM. Such anti-theft devices typically trigger in response to sensors that detect tampering with the machine or with the currency-holding portions of the machine. One method of destroying the currency is to deliver an indelible ink to deface or stain the currency so that it is easily identifiable as stolen, and thus no longer usable.

Currency in an ATM machine is typically dispensed from one or more currency cassettes that may be quickly loaded or unloaded in racks housed within the

machine. Typically, a cassette preloaded with currency is merely swapped with an empty or partially empty cassette when the machine requires currency replenishment.

Often, for anti-theft devices that dispense ink, the ink distribution system may require manual connection and disconnection to the cassettes during the loading and unloading process. This introduces an opportunity for human error either from incorrectly connecting the system or from omitting the connection entirely upon loading a new cassette. Thus, such an anti-theft system may be rendered inactive by human error, and therefore the ATM would be vulnerable to theft until the next time the machine is serviced. In addition, a disconnected or improperly connected ink delivery system presents another hazard in that it can still be triggered when not attached to the cassette, potentially spraying internal components of the ATM machine and causing permanent damage.

Also, the ink delivery systems of the current art are not optimized to provide maximized coverage of the currency. So, although the anti-theft device may render a significant percentage of the currency worthless, some portion may still be untouched by the ink, and thus still usable as legal tender. Given that dollar values in excess of $100,000 may be housed within a filled ATM, even if a relatively small percentage of the currency remains untouched after the anti-theft device is triggered, ATM theft may still be perceived as a worthwhile endeavor to the criminally inclined.

Finally, many anti-theft ink delivery systems of the current art require displacement of currency to make room for the anti-theft system within the currency cassette, thus reducing the money carrying capability of the ATM and requiring more frequent replenishment of funds.

Therefore, it is desirable to provide an anti-theft system for an ATM machine that maximizes the defacing ink or other liquid coverage on the currency, that fits within standard currency cassettes with minimal modification, and that does not displace currency. Furthermore, an anti-theft system is desired that requires no active

connecting step by the person who loads the currency cassette into the ATM and that disables flow of the defacing liquid unless a cassette is in place to receive the liquid.

SUMMARY

In accordance with the present invention, there is provided an Automatic Teller Machine (ATM) anti-theft system, as well as an ATM comprising such an anti-theft system, adapted to detect attempted theft and deface currency housed within currency cassettes in the ATM in response to the attempted theft. The anti-theft system comprises at least one theft-detection sensor capable of activating a trigger signal, a source of pressurized gas releasable in response to the trigger signal, and at least one reservoir connected to the pressurized gas source and containing currency-defacing liquid, such as indelible ink. Each reservoir is adapted to release the currency-defacing liquid into at least one first, safe-wide liquid distribution system upon the reservoir reaching a set pressure as provided by the pressurized gas. A coupling device connects each first liquid distribution system to a second, cassette liquid distribution system located within the currency cassette. A spray manifold, located within the currency cassette and connected to the second liquid distribution system, is adapted to forcibly discharge and distribute the liquid upon the currency. The coupling device may be an automatic coupling device connected to each first liquid distribution system and adapted to automatically connect the first liquid distribution system to the second, cassette liquid distribution system.

The spray manifold may be a cylindrical tube having a longitudinally spaced series of radial slits in the tube wall adapted for discharge of the liquid therefrom, the slits being perpendicular to the tube length and facing the currency. In particular, the radial slits may be 90° circumferential slits uniformly spaced along the tube length in alternating quadrants facing the currency.

The automatic coupling device may further comprise a spring-loaded valve stem having an extended position and a depressed position relative to an integral

valve body, the valve stem adapted to prevent flow of liquid therefrom except when in the depressed position.

The automatic coupling device may further comprise a linkage that translates motion of the linkage in a first direction to motion of the valve body in a second, perpendicular direction. The linkage may be translated in the first direction by an actuated cylinder, such as a pneumatic cylinder connected to the pressurized gas source. There may be a rupture disk between the currency-defacing liquid and the liquid distribution system, the bursting pressure of the rupture disk being greater than the actuation pressure of the pneumatic cylinder.

The linkage may further comprise a U-shaped bracket having opposite sides between which the valve body is located, each side having one or more angular slots therethrough. Pins protruding from the valve body are disposed in the angular slots so that movement of the linkage in the first direction causes movement of the valve body in the second direction.

The reservoir may further comprise a bladder mounted therein in which the currency-defacing liquid is contained to providing isolation of the liquid from the pressurized gas source. A perforated bladder tube disposed within the bladder may facilitate emptying of the bladder through the perforated bladder tube upon pressurization of the reservoir by the pressurized gas, independent of reservoir orientation.

The pressurized gas source may be a gas-containing canister, such as a carbon dioxide (CO_2) canister. The system may further comprise a puncture mechanism adapted to puncture the gas canister in response to activation of the trigger signal.

The invention also comprises a method of deterring theft of currency from Automatic Teller Machines. The method comprises detecting attempted theft via at least one theft-detection sensor, activating a trigger signal, and in response thereto,

releasing pressurized gas into a reservoir containing currency-defacing liquid. Next, the currency-defacing liquid is released into a first, safe-wide liquid distribution system after the reservoir reaches a set pressure from the pressurized gas released therein. Finally, the currency-defacing liquid flows from the first liquid distribution system into a second, cassette liquid distribution system and is forcibly discharged and distributed over the currency from a spray manifold within the currency cassette connected to the second liquid distribution system. The method may comprise automatically connecting the first and second liquid distribution systems just prior to the currency-defacing liquid flow.

The present invention also comprises a method for installing an anti-theft device of the present invention in a pre-existing ATM having a safe and at least one currency-containing cassette. The method comprises installing in a portion of the safe not otherwise occupied by components of the pre-existing ATM: at least one theft-detection sensor, a source of pressurized gas, at least one reservoir containing currency-defacing liquid, and a first, safe-wide liquid distribution system. The retrofit method further comprises installing the second, cassette liquid distribution system and spray manifold connected thereto in each pre-existing currency cassette, preferably without affecting the currency carrying capacity of the cassette. Finally, the installation method may comprise installing an automatic coupling device adjacent to and just outside each currency cassette for connection of the first and second liquid distribution systems to one another.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is a front view diagram of a typical ATM machine with the safe door open, showing currency cassettes and an anti-theft system of the present invention therein.

Figure 2A is a side view diagram of a typical currency cassette with its side partially cut away and its lid open.

Figure 2B is a face view diagram of a typical piece of currency and the currency holder pressed thereupon.

Figure 3A is a top view diagram of an exemplary currency cassette lid in partial cutaway, showing the location of the spray manifold in accordance with the anti-theft system of the present invention.

Figure 3B is a side view diagram of an exemplary lid of a currency cassette showing a connection to the cassette liquid distribution system.

Figure 4A is a detailed drawing of the bottom side of an exemplary spray manifold of the present invention, having 90° circumferential slits alternating side to side.

Figure 4B is a detailed drawing of the bottom side of another exemplary spray manifold of the present invention, having centered slits.

Figure 5 is a partial cutaway top view diagram of an exemplary liquid reservoir of the present invention.

Figure 6A is a partial cutaway side view diagram of an exemplary gas cartridge and actuation mechanism used in an anti-theft system of the present invention.

Figure 6B is an enlarged cutaway side view diagram of the encircled portion of Figure 6A.

Figure 7 is a schematic diagram of an exemplary liquid distribution system of the present invention.

Figure 8A is a top view diagram of an exemplary automatic coupling device of the present invention.

Figure 8B is a side view diagram of an exemplary automatic coupling device of the present invention, having a partially cutaway section at the valve body.

Figure 8C is an enlarged cutaway side view diagram of the encircled area of Fig 8B, showing the valve body portion of the automatic coupling device.

DETAILED DESCRIPTION OF INVENTION

The invention will next be illustrated with reference to the figures wherein similar numbers indicate the same elements in all figures. Such figures are intended to be illustrative rather than limiting and are included herewith to facilitate the explanation of the apparatus of the present invention.

Referring to Figure 1, there is shown a typical stand-alone automatic teller machine (ATM) 20 having a screen 22 for displaying information, an alphanumeric keypad 24, an ATM card slot 26, a currency withdrawal port 30 and receipt printer 32, all of which are user interfaces, and a safe 40. Safe 40 is shown with safe door 42 open to reveal the internal components of the ATM, including currency cassettes 44. Currently available ATMs may have anywhere from one to four cassettes, and the cassettes may be of any size and shape as designed by specific ATM machine equipment manufacturers. The cassettes 44 typically are aligned within ATM 20 on racks 45. Thus, cassettes 44 slide in and out on racks 45 to allow replacement of the cassettes when necessary. The components described above are well known in the art. Fig. 1 thus represents any ATM known in the art into which an anti-theft system of the present invention is installed.

In accordance with the present invention, ATM 20 as illustrated in Fig. 1 is equipped with an exemplary anti-theft system 21 of the present invention. Such anti-theft system 21 comprises one or more theft-detection sensors 41A and 41B capable of activating a trigger signal. Sensors 41A and 41B are electrically connected to a logic controller 151 that interprets electrical signals from the anti-theft sensors as well as from other sensors, such as combination lock sensor 41C that indicates when

safe door 42 has been opened properly. To ease clutter in Fig. 1, the connecting wiring between the sensors and the logic controller is not illustrated. Logic controller 151 sends out a trigger signal if it determines a theft is in progress. Anti-theft system 21 further comprises a source, such as a canister 123, of pressurized gas, such as a carbon dioxide (CO_2) releasable in response to the trigger signal. The pressurized gas pressurizes one or more reservoirs 100 of currency-defacing liquid connected to gas canister 123. Upon each reservoir 100 reaching a set pressure as provided by the pressurized gas, each reservoir releases the currency-defacing liquid into a first, safe-wide liquid distribution system 148 attached thereto. An automatic coupling device 170 connected to each first liquid distribution system 148 automatically connects each first liquid distribution system to a second, cassette liquid distribution system (not shown in Fig. 1) located within lid 52 of currency cassette 44. A spray manifold (not shown in Fig. 1) connected to each second liquid distribution system forcibly discharges and distributes the currency-defacing liquid upon the currency in each cassette.

Because reservoir 100 and gas canister 123 are located outside currency cassettes 44, the bulk of anti-theft system 21 of the present invention can be deployed inside safe 40 in areas previously not occupied by pre-existing components of the ATM, rather than displacing currency within cassette 44 and decreasing the cash-dispensing capacity of the machine. Thus, anti-theft system 21 of this invention may be retrofitted into pre-existing ATMs without requiring substantial installation space. As described herein below, the second liquid distribution system and spray manifold inside cassette 44 can be located within lid 52 of the cassette so that no currency is displaced. Furthermore, because the first and second liquid distribution systems are not connected until the trigger signal has been activated, no potentially human-error-inducing manual connection step is required between first and second liquid distribution systems each time cassettes 44 are loaded into ATM 20.

Although described herein with respect to specific embodiments, such embodiments are not limiting. Thus, generally, anti-theft system 21 of this invention

may comprise any theft-detection sensor known in the art capable of activating any type of trigger signal; any source of any pressurized gas known in the art; any of various types of reservoirs known in the art containing any currency-defacing liquid; any automatic coupling device adapted to automatically connect a two liquid distribution systems to one another; and any spray manifold design adapted to forcibly discharge and distribute currency-defacing liquid.

Referring now to Figures 2A-4B there are shown the essential details of a typical cassette 44 used in ATMs, having currency 46 housed therein. Holder 47 (shown in detail in Figure 2B) compressively holds the currency in place. Each piece of currency 46 from its face view as shown in Figure 2B, has a length L1 and a width W. Holder 47 typically compresses the bills face to face in a horizontal stack of dimension H. Because holder 47 exerts compressive force across the central portions of the bill faces, the upper corners 50 and lower corners 50' of the bill faces are the least compressed areas, and thus least resistant to penetration by liquid. A side view of such stacked currency as retained in cassette 44 is shown in Figure 2A. As shown in Fig. 2A, cassette 44 includes a cassette lid 52, which may be any standard cassette lid as known in the art modified in accordance with the present invention.

Mounted to cassette lid 52 in accordance with the present invention is an exemplary spray manifold assembly 54 as shown in Figure 3A. Spray manifold assembly 54 has a length L2 oriented parallel to currency stack dimension H when lid 52 is closed. The spray manifold receives liquid from cassette liquid distribution system 55 inside the cassette, as seen in Figures 3A and 3B. This cassette liquid distribution system comprises tubing 57, which may be any plastic or metal tubing known in the art, and couplings 59 and 59'. Coupling 59' is attached to bushing 61, which is affixed in a hole drilled in the side of lid 52. Bushing 61 neither protrudes nor is recessed into lid 52, being substantially even with the lid surface. Bushing 61 is the point of connection between cassette liquid distribution system 55 inside cassette lid 52 and safe-wide liquid distribution system 148 via automatic coupling device 170 (system 148 and device 170 shown in Fig. 1).

Exemplary spray manifold assembly embodiments 54 and 54' are shown in Figures 4A and 4B respectively in bottom view. Each spray manifold assembly 54 and 54' further comprises entry point 56, end caps 58 (shown in sectional view) affixed and leak-protected with sealant 60, and tubular spray manifold 62 having apertures 64 or 64' cut radially in the circumferential sidewall of the manifold.

In one embodiment, shown in Figure 4A, spray manifold assembly 54 may have apertures 64 in the form of slits uniformly spaced along length L2 and cut into alternating 90° circumferential sections of the spray manifold. The slits are oriented perpendicular to spray manifold length L2, parallel to currency length L1 and facing currency 46 so that alternating slits aim toward alternating upper corners 50 of the currency. Each such slit begins at the bottommost point of the tube and extends 90° around the circumference thereof in the alternate direction of the previous slit, thus resulting in 90° circumferential slits uniformly spaced along the spray manifold length in the alternating bottom quadrants facing the currency.

In an alternate embodiment shown in Figure 4B, slits 64' of spray manifold assembly 54' may cover the full 180° bottom portion of the spray manifold centered on and facing the currency, or some centered fractional portion thereof. Yet another alternate spray manifold assembly embodiment may comprise some combination of slits 64 and 64', such that 90° circumferential slits may be uniformly spaced in repeating groups of three, alternating from a slit directed at one corner, to a slit directed at the center, to a slit directed at the other corner and so on. The apertures in tubular spray manifold 62 could alternatively be grouped in sets of linearly aligned round holes to provide the same coverage as the slits, or could be in the form of small nozzles sized to provide a similar or some other optimal spray pattern toward the currency. Other spray manifold designs known in the art and modifications thereof may also be used in place of the embodiments described herein.

Apertures 64 are preferably very narrow, thus maximizing the spray velocity. For instance, in one embodiment, the slits are 6/1000 of an inch wide in ¼-

inch outer diameter aluminum tubing. High liquid velocity increases the coverage of the liquid on the currency. The use of slits oriented parallel to length L1 of the currency allows the fan-shaped, high-velocity spray pattern of the liquid to penetrate beyond the edges of the bill inside to the faces of the currency, particularly in that part of the currency beyond the outline of the currency holder that clamps it under maximum pressure.

Referring now to Figure 5, there is shown an exemplary liquid reservoir 100 with its cover 102 shown cut away to reveal collapsible bladder 104 inside. In accordance with one embodiment of the present invention, one such reservoir 100 is included for each cassette in the ATM. Bladder 104 contains currency-defacing liquid 103, illustrated in the cutaway of bladder 104 in Fig. 5. The currency-defacing liquid may be an indelible ink such as ink sold by Imperial Chemical Industries PLC of Millbank, United Kingdom under the trade name Securi-Dab™, and/or having a composition in accordance with U.S. Patent 5,449,400 to Van Lint *et al.*, which has been assigned to the common assignee of this application and is incorporated herein by reference. Other currency-defacing liquids are known in the art, for example, but not limited to, liquids that blur the currency, may also be used.

Liquid 103 exits bladder 104 and reservoir 100 through liquid release coupling 108. Exemplary liquid release coupling 108 further comprises a nipple 110 having interior and exterior threads and extending into the reservoir. Nipple 110 is secured to the reservoir with nut 111 that fits over the nipple exterior threads. Nipple 110 is also sealed in place with sealant adhesive rated for high pressures, such as silicon glue. A tubing coupling 112 is threaded into the internal threads of nipple 110, enabling attachment of the reservoir to tubing for fluid transport of liquid 103.

Bladder 104 is typically attached to interior extension 109 of nipple 110 by a clamp 114. Bladder tube 105 inserts through interior extension 109 of nipple 110 and almost to tubing coupling 112. Bladder tube 105 has a plurality of perforations 107 therein, which may be in the form of slits. Inside nipple 110, between tubing coupling 112 and bladder tube 105, is a rupture disk 120, typically made of

PTFE or other non-corrosive material. Rupture disk 120 prevents liquid flow out of the bladder until a desired pressure is reached. Once the liquid begins flowing, bladder tube 105 prevents the bladder from collapsing around interior extension 109 and closing off flow before the bladder is empty. Perforations 107 extend the entire length of the portion of bladder tube 105 contained within bladder 104, so that regardless of the bladder orientation or the resulting location of the liquid level line, liquid 103 will have a route to escape through the tube.

Reservoir 100 also has a gas coupling 121 attached thereto, into which pressurized gas can flow from a gas distribution system (not shown). The gas distribution system is connected to a pressurized gas actuation device, an example of which is shown in greater detail in Figures 6A and 6B.

Referring now to Figures 6A and 6B, there are shown partial cross-sectional and cross-sectional views, respectively, of exemplary actuation device 122 comprising a housing 126 in which there is contained a sharp-nosed projection 130 capable of piercing the seal 131 of canister 123. Canister 123 typically contains a gas 125 such as carbon dioxide (CO_2) under pressure. Sharp-nosed projection 130 is integral to bracket 135 that compresses coil actuation spring 134. Prior to actuation, the spring is kept from expanding by one or more detents 136 disposed within slots in bracket sides 133. Each detent rests against a ledge 128 in housing 126 and is prevented from moving inward by interposer 138, through which a fusible link 144 is affixed. Fusible link 144 attaches the interposer to backplate 132 of bracket 135 and may be in the form of a nylon or other plastic screw threaded into interposer 138. Heater wire 140 wraps around fusible link 144 and is connected to electrical actuation wire 142 via rivets 141 through backplate 132.

When a signal is received to trigger the anti-theft device, the electrical actuation wire 142 is energized, thus heating heater wire 140. The heat from heater wire 140 makes fusible link 144 pliable, thus allowing it to stretch enough that each detent 136 collapses inward into interposer groove 139, thus freeing bracket 135 from its position adjacent housing ledge 128. Spring 134 then expands with great force,

thereby propelling sharp-nosed projection 130 into canister 123, puncturing seal 131. The gas thus released through pierced seal 131 escapes through housing outlet 146. Other actuation devices known in the art for releasing gas from a gas canister may also be used with this invention.

The compressed gas exits housing outlet 146 into a gas distribution system and through gas coupling 121 into reservoir 100, thus pressurizing reservoir 100. Collapsible bladder 104 inside the reservoir is thus pressurized enough to break rupture disk 120, allowing liquid to flow out of bladder 104 through liquid release nozzle 108 and into the liquid distribution system. In the system described herein, the bladder isolates the liquid and the liquid distribution system from the gas and the gas distribution system. In an alternate embodiment, however, reservoir 100 may contain the liquid without any bladder separating the gas and liquid systems, and thus the combined liquid and gas would exit reservoir 100 through rupture disk 120 into the ink distribution system.

Referring now to Figure 7, there is shown a schematic representation of various portions of an exemplary anti-theft system of the present invention, in this case a system used to protect an ATM having four cassettes, such as is illustrated in Fig. 1. In Figs. 1 and 7, gas distribution system 147 is illustrated using dashed lines and liquid distribution system 148 is illustrated using solid lines. Electrical trigger signal 149 from theft detection sensor 151 is represented by a dotted line in Fig. 7.

Liquid and gas distribution systems 148 and 147, respectively, may comprise metal or plastic tubing rated for the corresponding gas and liquid pressures and materials to which the distribution systems are exposed in this application, as are well known in the art. The working pressure may be the standard pressure available in standard gas canisters, or a pressure that is regulated down, if necessary, by devices well-known in the art. The working pressure, however, is sufficient to overcome pressure-drop in the gas and liquid distribution systems and propel the defacing liquid into the currency with a desired amount of force adequate to sufficiently deface the currency.

When attempted theft is detected, puncture mechanism 124 receives a trigger signal 149, such as from logic controller 151. As previously described, canister puncture mechanism 124 punctures canister 123, allowing gas to escape the canister. The gas flows into gas manifold 150 which splits the gas flow along arrow "A" toward the liquid reservoirs 100, and along arrow "B" toward automatic coupling devices 170, to be described in detail hereinafter. Gas manifold 150 may further comprise a relief valve 152 typical of relief valves standard in the art, used in this case to prevent over-pressurization of the gas distribution system.

In the embodiment shown in Fig. 7, gas flows along arrow "A" into liquid pressurization manifold 154 that splits the gas flow into multiple pathways, one for each reservoir 100. The embodiment shown in Figure 7 has one reservoir for each cassette, so there are four reservoirs 100 and four dedicated safe-wide liquid distribution systems 148 serving an ATM with four cassettes such as ATM 20 shown in Fig. 1. Inside each reservoir, as previously detailed, the bladder is compressed to the rupture point of the rupture disk and liquid flows from each reservoir into and through its respective dedicated liquid distribution system 148 to automatic coupling device 170. The function of the automatic coupling device will be detailed hereinafter. Instead of providing one reservoir and one dedicated safe-wide liquid distribution system for each cassette, other embodiments may comprise a single large reservoir and a single safe-wide distribution system having branch connections to each automatic coupling device. The system having dedicated reservoirs and liquid distribution lines for each cassette as depicted in Fig. 7, however, provides better control of flow distribution to each cassette than a system having a single reservoir and a single distribution system.

At the same time gas flows along arrow "A", gas also flows along arrow "B". This gas flows through coupling device hold valve 160. Coupling device hold valve 160 further comprises a check valve 162 in the gas pathway allowing gas to flow only in the direction of arrow "B'". Hold valve 160 also comprises purge valve 164 that allows any gas trapped by check valve 162 to be bled out gradually. Thus,

the designation "hold valve" denotes that once pressure flows through the check valve 162, it is held behind the check valve until it gradually bleeds off. In a preferred embodiment, purge valve 164 is a throttle valve commonly known in the art that gradually bleeds pressure out through either a small aperture or a section of porous material. After hold valve 160, gas then flows into splitter 166, which may be in the form of a block manifold, or one or more tubing "Y" connections well known in the art. As shown in Figure 7, the gas is split four ways, each way leading to an automatic coupling device 170.

Automatic coupling device 170 provides a connection point between safe-wide liquid distribution system 148 external to the currency cassette (shown schematically in Figure 7) and the cassette liquid distribution system 55 inside the currency cassette (shown in Figure 3A). One feature of the automatic coupling device is that it does not make contact with the currency cassette until the anti-theft device triggers.

For the embodiment shown in Fig. 1, the automatic coupling fits between rack 45 and cassette lid 52, yet still automatically connects safe-wide liquid distribution system 148 to cassette liquid distribution system 55 in cassette 52 via bushing 61 (system 55, cassette 52, and bushing 61 shown in Figs 3A and 3B). To provide both the narrow profile and the automated coupling action, automated coupling device 170 translates motive force supplied in a first direction (parallel to the sliding action of the cassettes 44 in and out of racks 45, where ample longitudinal space is available) into a second, perpendicular coupling force and motion directed toward and engaging bushing 61 on the side of cassette lid 52 (as shown in Fig. 3B). Bushing 61 and corresponding coupling device 170 may be located on either side or even in the rear or on top of cassette lid 52, as required to meet the installation clearances available for the ATM to be retrofitted. Although shown in Fig. 1 mounted between lid 52 and rack 45, coupling device 170 can be mounted on the other side of rack 45 such that the portion that connects with bushing 61 extends in and out of holes or gaps (not shown) in the rack.

A detailed view of an exemplary automatic coupling device 170 is shown in Figures 8A – 8C. Automatic coupling device 170 comprises base 171, pneumatic cylinder 172 attached to the base, and pneumatic cylinder rod 174 extendable from pneumatic cylinder 172 and attached to a linkage 176. Linkage 176 comprises a U-shaped bracket 177 having an end 181 and opposite sides 179 that interface with valve body 178 mounted therebetween. Pins 182 attached to valve body 178 protrude through angled slots 180 in each bracket side 179. Alignment pins 183 attached to the base, or to a mounting block fixed to the base, also protrude through horizontal slots 187 in each bracket side to help guide the bracket motion. The liquid distribution system is attached to valve body 178 via tubing (not shown) connected to liquid coupling 184.

When pneumatic cylinder 172 is actuated, rod 174 traverses in the direction of arrow "C", and the interior edges of slots 180 act on pins 182 to force valve body 178 upward in the direction of arrow "D". Pin 200, attached to valve body 178 and protruding through a vertical slot (not shown) in vertical projection 202 of base 171, prevents horizontal movement of valve body 178.

Pins 182, 183, and 200 may be in the form of screws threaded into tapped holes in the valve body, the screw heads thus keeping the ends of the pins in the slots. Base 171 and bracket 177 may each be made from thin, stamped pieces of a metal, such as aluminum or stainless steel. Pneumatic cylinder rod 174 typically has a threaded end 173 that is fastened to end 181 of U-shaped bracket 177 with nuts 175. Other pin configurations may also be used, as are known in the art.

In alternate embodiments, automatic coupling devices having other linkages or mechanisms for translation of motion in a first direction to motion in a second direction may also be utilized. In some ATM configurations, where space permits, the anti-theft system may comprise an automatic coupling device without any translation of motion from one direction to another, in which case the automatic coupling motion may, for instance, be provided merely by a pneumatic cylinder that

directly couples the coupling device to the cassette along the direction of cylinder extension.

In yet another embodiment, the coupling device may be any manual male/female coupling known in the art that is connected and disconnected manually at the time the cassettes are interchanged. Such manual connection may be a discrete connection step performed by service personnel or an inherent function of fully inserting the cassette in the rack. For instance, one component of the coupling may be mounted in the rear of the rack and the mating component mounted in the rear of the cassette so that the components securely connect together whenever the cassette is properly and completely inserted.

As shown in more detail in the cutaway, cross-sectional portion of Figure 8C, exemplary valve body 178 of automatic coupling device 170 has a compression gasket 193 mounted thereon, and further comprises spring-loaded valve stem 186. When valve body 178 moves upward, valve stem 186 engages bushing 61 in lid 52 of cassette 44 (shown in Figure 3A). Bushing 61 is sized so that when valve body 178 engages the bushing, the bushing depresses spring-loaded valve stem 186, thus allowing liquid to flow. If there is no cassette installed, valve stem 186 makes contact with nothing, and thus is never depressed to allow ink to flow, as spring 188 keeps the valve stem in an extended state. Automatic coupling device 170 thus prevents liquid from spraying the internal structure of the ATM if the anti-theft device is triggered without a currency cassette present.

Valve body 178 has a passage 185 therein where liquid flows from liquid coupling 184 into liquid chamber 190. The liquid is kept from leaving the chamber when valve stem 186 in an extended state by wide diameter portion 192 of valve stem 186 disposed above the entry point of passage 185 into chamber 190. When valve stem 186 is depressed, apertures 194 (four, spaced 90° apart) plunge into chamber 190 below the entry point of passage 185, and liquid flows through the apertures and into valve stem 186.

Thus, if the cassette is completely misaligned, the valve stem depresses, but compression gasket 193 pressed against the cassette lid creates a seal to prevent liquid from flowing. If the cassette is partially misaligned, the valve stem depresses, and liquid flows through any overlapping portion of valve stem 186 and bushing 61. Automatic coupling device 170 thus also prevents liquid from spraying the internal structure of the ATM if the anti-theft device is triggered when a currency cassette is completely or slightly misaligned with the coupling device. Other spring-loaded or other valve designs capable of preventing flow unless a coupling connection has been made may also be used as are known in the art

As detailed previously, the same pressurized gas that is used for propelling the defacing liquid actuates pneumatic cylinder 172. In one embodiment of the invention, the actuation pressure required to extend rod 174 is less than the burst pressure of rupture disk 120. Thus, the liquid distribution system connection to the currency cassette is already completed before the rupture disk 120 bursts to release liquid into the liquid distribution system. Although the delay between connection to the cassette and bursting of the disk may be measurable in mere fractions of a second, this delay nevertheless minimizes liquid pressure in the valve body 178 when the automatic coupling valve actuates. High liquid pressure otherwise might resist depression of valve stem 186 in excess of the resistance of spring 188, and might thus prevent valve stem 186 from depressing enough to enable liquid flow.

The trigger signal for the anti-theft mechanism may be a direct output from a single anti-theft sensor, or may be a signal resulting from a network of various sensor and logic combinations well-known in the art. Microswitches 41A, such as any microswitch known in the art, may be used to detect the position of the housing door or safe door as shown in Fig. 1. One or more sensors 41B for detecting vibration or tilting, as shown in Fig. 1, such as mercury switches or other sensors commonly known in the art, may be used to determine if the ATM is experiencing tampering or vandalism. In the embodiment shown in Fig. 1, electrical outputs from all of the sensors are networked to logic controller 151, such as a microprocessor, that contains

pre-programmed logic to process the outputs and send a trigger signal, if deemed appropriate. The trigger signal initiates anti-theft measures, such as puncturing gas cylinder 123 to activate coupling mechanism and to pressurize currency-defacing liquid in reservoir 100 as described herein. In addition to the currency-defacing response as described herein, such anti-theft measures may include sounding an audible alarm or sending a silent signal to a security system manager or to law enforcement personnel. For certain mildly-threatening combinations of sensor outputs, an audible alarm alone may be initiated first to attempt to repel potential robbers, and the currency-defacing step saved for later, more threatening combinations of sensor outputs. There may be more than one potential predetermined combination of sensor outputs that may trigger the anti-theft measures.

Exemplary sensors as shown in Fig. 1 and described herein above depict merely a few of the sensors that may have outputs networked into microprocessor 151. Anti-theft sensors similar to sensors 41A and 41B but located in different positions on ATM 20, as well as other types of anti-theft sensors known in the art, may be incorporated into the sensor network that feeds microprocessor 151. Additionally, microprocessor 151 may also receive output signals from a number of master disabling switches or sensors to be activated when servicing the ATM machine. For instance, combination lock sensor 41C, shown in an open position in Fig. 1, detects whenever safe door 42 has been opened properly, thus disabling the anti-theft system. Particularly critical sensors, such as combination lock sensor 41C, may be installed in multiple for redundancy. The microprocessor logic configuration may include timers and delay sequences such as for example, but not limited by, the logic configuration described in U.S. Patent 5,410,295 to Van Lint, which has been assigned to the common assignee of this application and is incorporated herein by reference.

Although the anti-theft system of the present invention may be designed for and installed in a new ATM prior to putting that ATM into service, the present invention is particularly advantageous for retrofitting a pre-existing ATM because the various components of the system may be installed in available space not

otherwise occupied by components of the pre-existing ATM. For instance, referring now to Fig. 1, an exemplary installation method for the anti-theft system may comprise installing theft-detection sensors 41A and 41B, canister 123 of pressurized gas, at least one reservoir 100, gas distribution system 147, and safe-wide liquid distribution system 148 within safe 40. Retrofitting safe 40 may include, where desired, installation of other theft-detection and interlock sensors and switches as well as logic controller 151 capable of translating sensor output into a trigger signal.

The retrofit method further comprises installing cassette liquid distribution system 55 and spray manifold 54 connected thereto in each pre-existing currency cassette 44 (as shown in Fig. 3A). Preferably, cassette liquid distribution system 55 and spray manifold 54 may be installed outside of the section of cassette 44 designated for containing currency 46 (shown in Fig. 2A) such that system 55 and manifold 54 do not displace currency 46. For instance, as shown in Fig. 3A, system 55 and manifold 54 may be installed in cassette lid 52. Finally, the installation method may comprise installing automatic coupling device 170 adjacent to each currency cassette 44 for connection of safe-wide liquid distribution system 148 to cassette liquid distribution system 55. In alternate embodiments, manual connections may be provided for connecting the safe-wide liquid distribution system 148 to cassette liquid distribution system 55, such as connections that are engaged whenever cassette 44 is fully inserted within rack 45 or connections that are manually coupled by service personnel each time the cassettes are replaced.

As described in the background section herein, routine replenishing of currency in ATM machines often comprises replacing empty or nearly-empty currency cassettes with full cassettes rather than opening each individual cassette for replacement of the currency. Similarly, therefore, the installation method for retrofitting a pre-existing ATM machine 20 may comprise completely replacing a pre-loaded, pre-existing currency cassette (not shown) with a modified currency cassette 44. Thus, the installation method may comprise installing cassette liquid distribution system 55 and spray manifold 54 within a pre-existing currency cassette remotely from

the ATM to be retrofitted. In such case the installation method further comprises merely replacing a pre-loaded currency cassette with the modified currency cassette. In this way, the retrofit of pre-existing ATM machines may be expedited, and minimizing machine downtime.

Although illustrated and described herein with reference to certain specific embodiments, the present invention is nevertheless not intended to be limited to the details shown. Rather, various modifications may be made in the details within the scope and range of equivalents of the claims and without departing from the spirit of the invention.

What is claimed is:

1. An automatic teller machine anti-theft system adapted to detect attempted theft and to deface currency housed within at least one currency cassette in response to said attempted theft, the anti-theft system comprising:

at least one theft-detection sensor capable of activating a trigger signal;

a source of pressurized gas releasable in response to said trigger signal;

at least one reservoir containing currency-defacing liquid and connected to said source of pressurized gas;

at least one first, safe-wide liquid distribution system, each adapted to receive said currency-defacing liquid from one of said at least one reservoirs upon said one reservoir reaching a set pressure as provided by said pressurized gas;

a second, cassette liquid distribution system located within each said currency cassette;

one or more coupling devices, each coupling device adapted to connect one of said first liquid distribution systems to one of said second liquid distribution systems; and

a spray manifold located within each said currency cassette and connected to said second liquid distribution system, said spray manifold adapted to forcibly discharge and distribute said liquid upon said currency.

2. The anti-theft system of claim 1 wherein each said coupling device is an automatic coupling device attached to said first liquid distribution system, each said automatic coupling device adapted to automatically connect one of said first liquid distribution systems to one of said second liquid distribution systems.

3. The anti-theft system of claim 1 wherein said spray manifold is a cylindrical tube having a length, a circumferential sidewall, and a series of longitudinally-spaced, radial slits in said sidewall adapted for discharge of liquid therefrom, said slits oriented facing said currency and perpendicular to said tube length.

4. The anti-theft system of claim 3 wherein the radial slits are 90° circumferential slits uniformly spaced along said length in alternating quadrants facing said currency.

5. The anti-theft system of claim 1 wherein the liquid is indelible ink.

6. The anti-theft system of claim 2 wherein each automatic coupling device is adapted to prevent flow of said currency-defacing liquid unless the coupling device is at least partially connected to one of said second liquid distribution systems.

7. The anti-theft system of claim 6 wherein each automatic coupling device further comprises a spring-loaded valve stem having an extended position and a depressed position relative to an integral valve body, said valve stem adapted to prevent flow of liquid therefrom when in said extended position.

8. The anti-theft system of claim 7 wherein each automatic coupling device further comprises a linkage that translates motion of said linkage in a first direction to motion of said valve body in a second, perpendicular direction.

9. The anti-theft system of claim 8 wherein each automatic coupling device further comprises an actuated cylinder adapted to traverse said linkage in said first direction.

10. The anti-theft system of claim 9 wherein said actuated cylinder is a pneumatic cylinder.

11. The anti-theft system of claim 10 wherein said pneumatic cylinder is connected to said pressurized gas source.

12. The anti-theft system of claim 8 wherein said linkage comprises:

a U-shaped bracket having opposite sides between which said valve body is located, each side having one or more angular slots therethrough; and

a plurality of pins protruding from said valve body, each of said pins penetrating one of the angular slots in said U-shaped bracket, the interface of said pins in said slots adapted to translate movement of said linkage in said first direction to movement of said valve body in said second direction.

13. The anti-theft system of claim 1 wherein each said reservoir further comprises a bladder mounted therein in which said currency-defacing liquid is contained, said bladder providing isolation of said liquid from said pressurized gas source.

14. The anti-theft system of claim 13 further comprising a perforated tube disposed within said bladder, said perforated tube adapted to, independently of reservoir orientation, facilitate egress of currency-defacing liquid therethrough to said first liquid distribution system upon pressurization of said reservoir by said gas.

15. The anti-theft system of claim 1 wherein each said reservoir further comprises a rupture disk between said currency-defacing liquid and the first liquid distribution system connected to said reservoir.

16. The anti-theft system of claim 1 wherein said source of pressurized gas is a canister.

17. The anti-theft system of claim 16 wherein said pressurized gas in said canister comprises carbon dioxide.

18. The anti-theft system of claim 16 further comprising a puncture mechanism adapted to puncture said canister in response to activation of said trigger signal.

19. The anti-theft system of claim 11 wherein:

each said reservoir further comprises a rupture disk between said liquid and said first liquid distribution system;

said rupture disk has a bursting pressure;

said pneumatic cylinder has an actuation pressure; and

said bursting pressure is greater than said actuation pressure.

20. The anti-theft system of claim 1 wherein the anti-theft system is adapted for installation in a pre-existing Automatic Teller Machine having pre-existing currency cassettes.

21. The anti-theft system of claim 20 wherein the second liquid distribution system and attached spray manifold do not occupy space designated for containing currency within said pre-existing currency cassette.

22. The anti-theft system of claim 1 further comprising a plurality of currency cassettes, each cassette having a dedicated said reservoir, a dedicated said first liquid distribution system, and a dedicated said coupling device corresponding thereto.

23. The anti-theft system of claim 1 further comprising a logic controller and a plurality of sensors including said at least one anti-theft sensor, each sensor having an electrical output connected to said logic controller, said logic controller adapted to activate said trigger signal upon receipt of at least one predetermined combination of electrical outputs.

24. An automatic teller machine comprising the anti-theft system of claim 1.

25. A method of deterring attempted theft of currency from an automatic teller machine, said method comprising:

a) detecting said attempted theft via at least one theft-detection sensor;

b) activating a trigger signal;

and in response to said trigger signal:

c) releasing pressurized gas into a reservoir containing currency-defacing liquid;

d) automatically connecting a first, safe-wide liquid distribution system to a second, cassette liquid distribution system via an automatic coupling device, said second liquid distribution system being located within a currency cassette containing said currency;

e) releasing said currency-defacing liquid into said first liquid distribution system when said reservoir reaches a set pressure resulting from said pressurized gas released therein; and

f) forcibly discharging and distributing said currency-defacing liquid over said currency from a spray manifold connected to said second liquid distribution system within said currency cassette, thereby defacing said currency.

26. The method of claim 25 wherein said automatic coupling device comprises a spring-loaded valve stem attached to a valve body, the valve stem having an extended position in which liquid flow is prevented and a depressed position in which liquid flow is enabled, the method further comprising in step (d) depressing said valve stem into said depressed position by contact with said second liquid distribution system when said first and second liquid distribution systems are automatically connected.

27. The method of claim 26 wherein the automatic coupling device comprises an actuated cylinder attached to a linkage attached to said valve body, the method further comprising in step (d) moving said linkage in a first direction whereby said linkage causes said valve body to move in a second, perpendicular direction into contact with said second liquid distribution system to depress said valve stem.

28. The method of claim 27 wherein the actuated cylinder is a pneumatic cylinder attached to said pressurized gas source, the method further comprising in step (c) also releasing pressurized gas into said pneumatic cylinder for actuation thereof.

29. The method of claim 28 wherein said reservoir further comprises a rupture disk between said currency-defacing liquid and said first liquid distribution system, said rupture disk having a bursting pressure greater than an actuation pressure of said pneumatic cylinder, the method further comprising fully actuating said pneumatic cylinder to couple said first and second liquid distribution systems in step (d) prior to bursting said rupture disk in step (e) and releasing said currency-defacing liquid into said first distribution system.

30. The method of claim 25 wherein said reservoir comprises a bladder mounted therein in which said currency-defacing liquid is contained, the method further comprising in step (c) compressing said bladder by pressurizing said reservoir with said pressurized gas and in step (e) releasing said liquid from said bladder into said first distribution system.

31. The method of claim 25 wherein the bladder contains a perforated tube disposed therein, the method further comprising in steps (e) and (f), substantially emptying said currency-defacing liquid from said bladder through said perforated tube, independent of reservoir orientation.

32. The method of claim 25 wherein the source of pressurized gas is a canister, the method further comprising in step (c) puncturing said canister with a puncture mechanism to release said pressurized gas.

33. A method of retrofitting a pre-existing automatic teller machine with an anti-theft system, the automatic teller machine comprising a safe having available space not occupied by pre-existing machine components and adapted to hold at least one pre-existing currency cassette having a designated section for containing currency, said method comprising:

a) installing in said available space within said safe:

at least one theft-detection sensor capable of activating a trigger signal;

a source of pressurized gas releasable in response to said trigger signal;

at least one reservoir for containing currency-defacing liquid and connected to said source of pressurized gas, and

at least one first, safe-wide liquid distribution system connected to each reservoir and adapted to receive said currency-defacing liquid upon said reservoir reaching a set pressure as provided by said pressurized gas;

b) installing in each said pre-existing currency cassette a second, cassette liquid distribution system and a spray manifold connected thereto, said spray manifold oriented and adapted to forcibly discharge and distribute said liquid upon said currency; and

c) providing a coupling device adapted to connect each said first liquid distribution to at least one second liquid distribution system.

34. The method of claim 33 wherein step (c) further comprises:

c) installing an automatic coupling device adjacent to each said currency cassette and connecting each said automatic coupling device to one of said first liquid distribution systems so that each automatic coupling device is positioned to couple the first liquid distribution system attached thereto to the second liquid distribution system in the adjacent currency cassette.

35. The method of claim 33 wherein step (b) further comprises installing said second liquid distribution system and said spray manifold within said pre-existing currency cassette in a location not within said designated section for containing currency.

36. The method of claim 33 wherein step (b) further comprises creating a modified currency cassette in a location remote from the pre-existing automatic teller machine by installing said second liquid distribution system and said spray manifold within a currency cassette interchangeable with said pre-existing currency cassette, the method further comprising removing the pre-existing currency cassette from the pre-existing automatic teller machine and replacing said pre-existing currency cassette with said modified currency cassette.

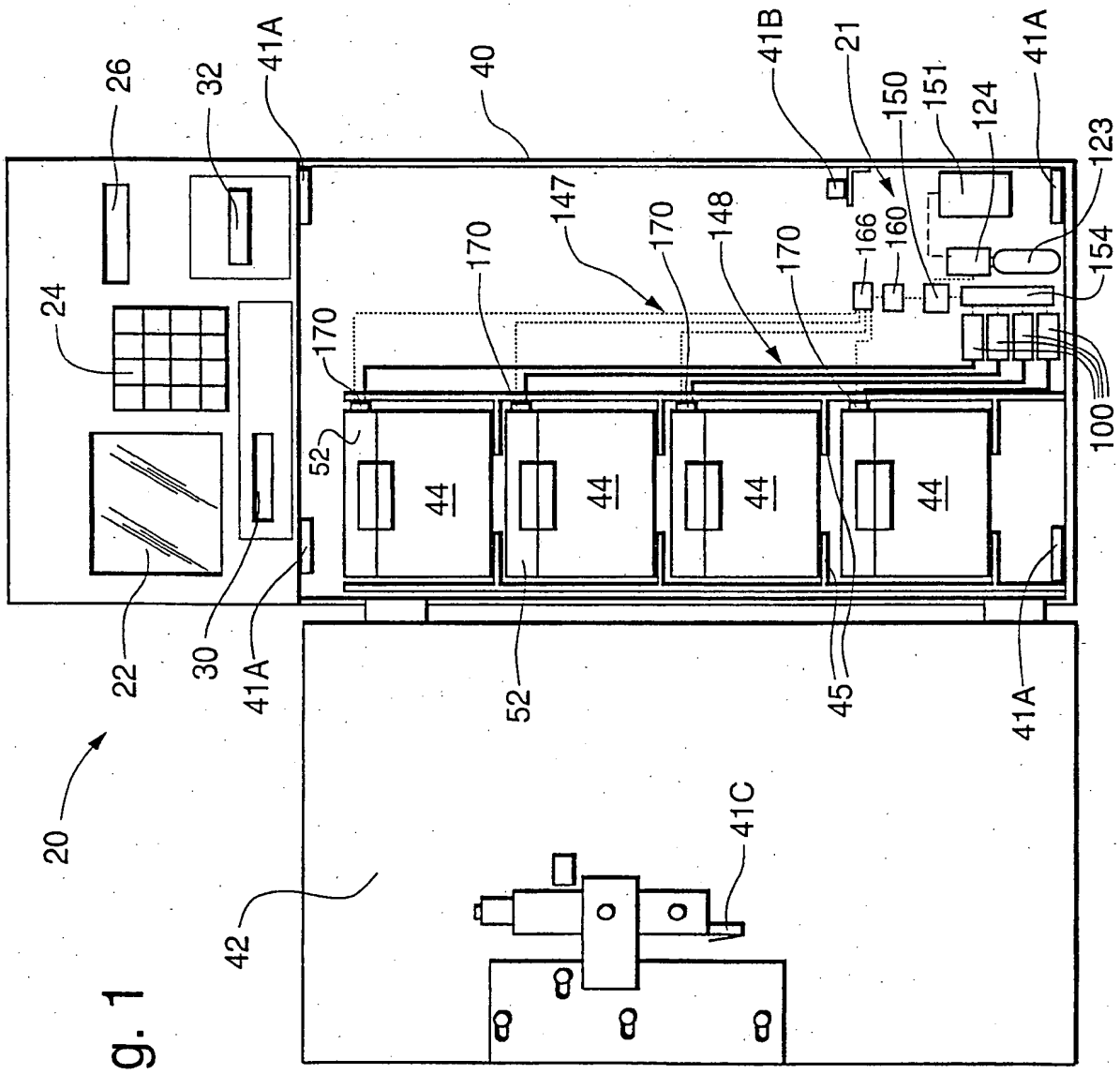
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Fig. 1

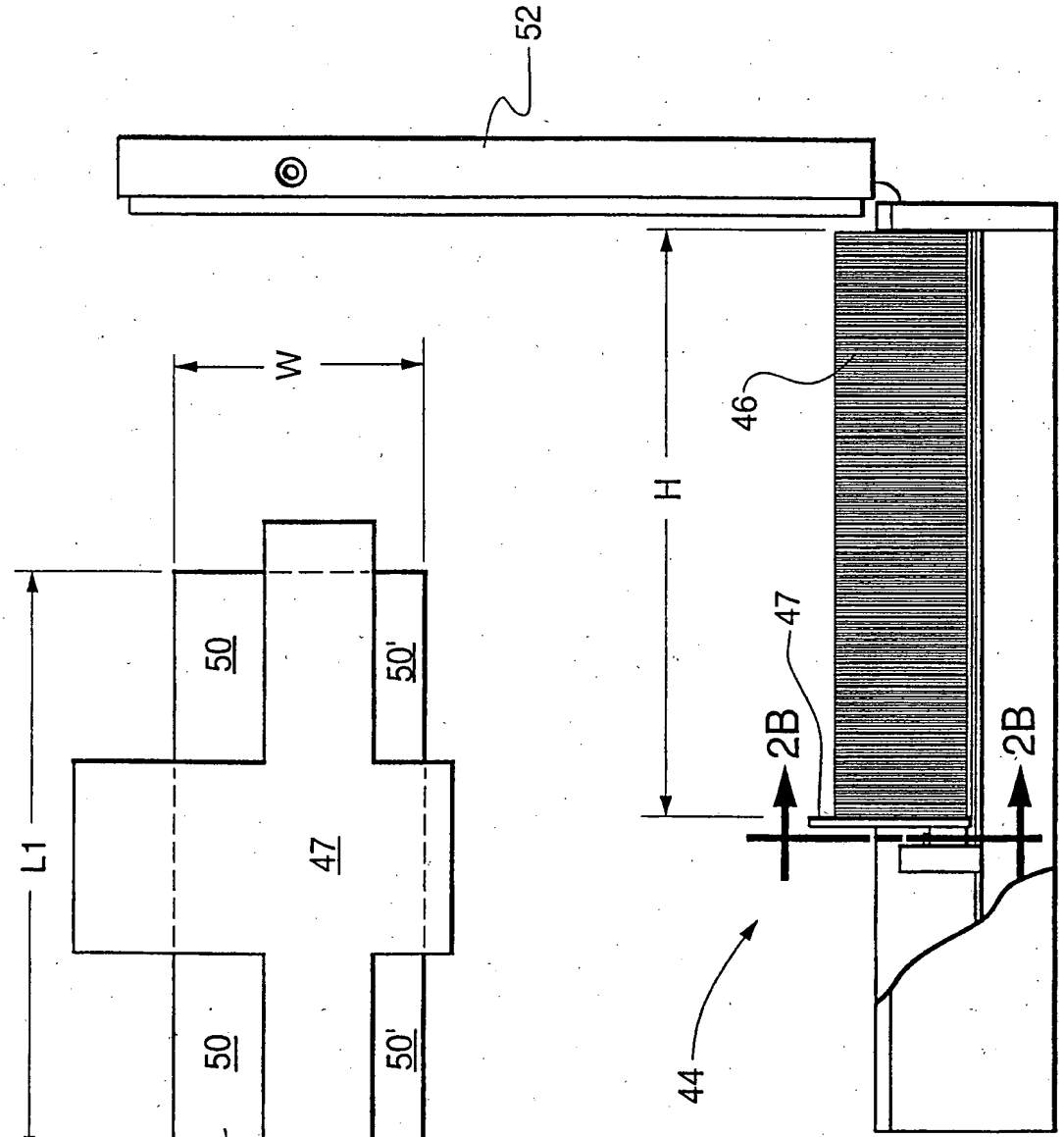

Fig. 2A

Fig. 2B

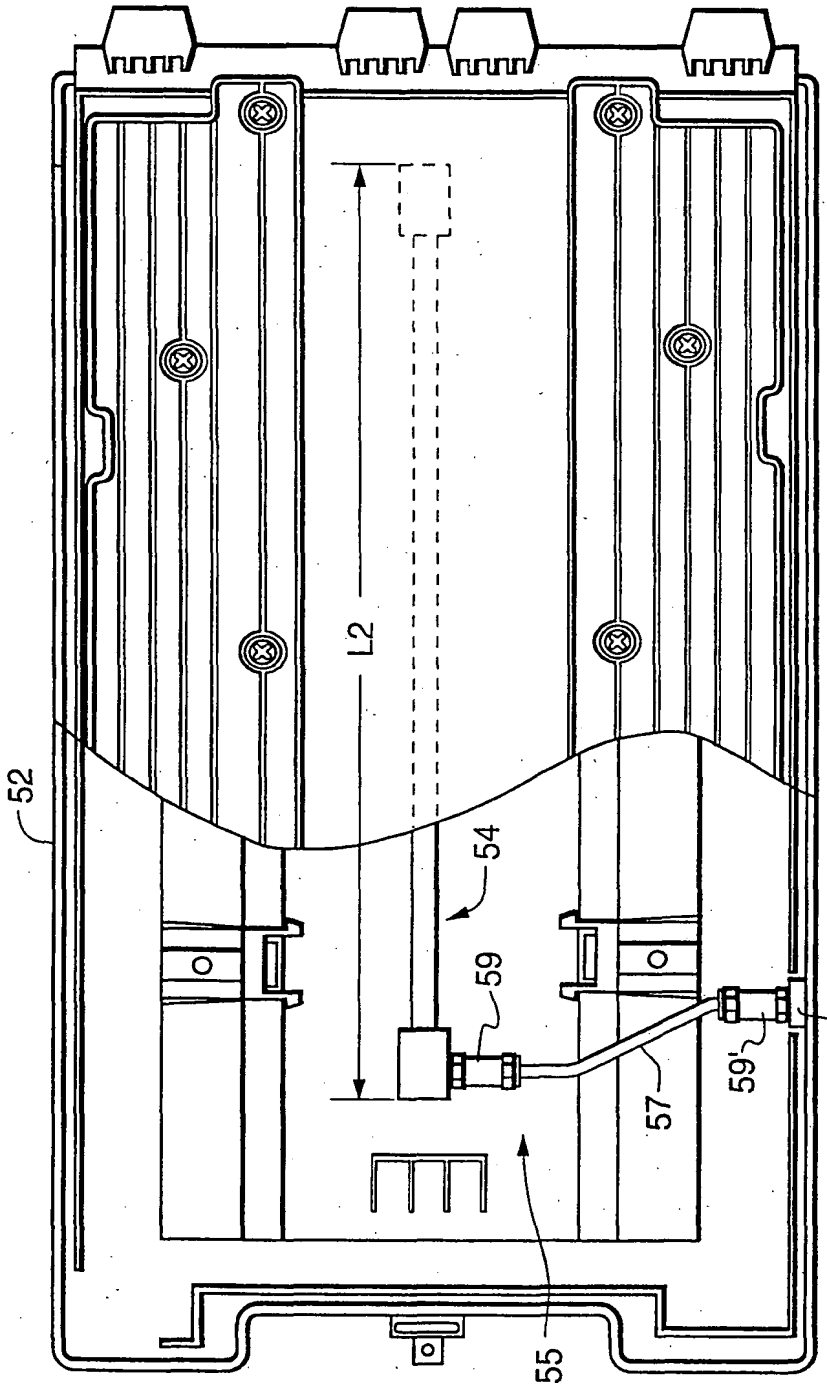

Fig. 3A

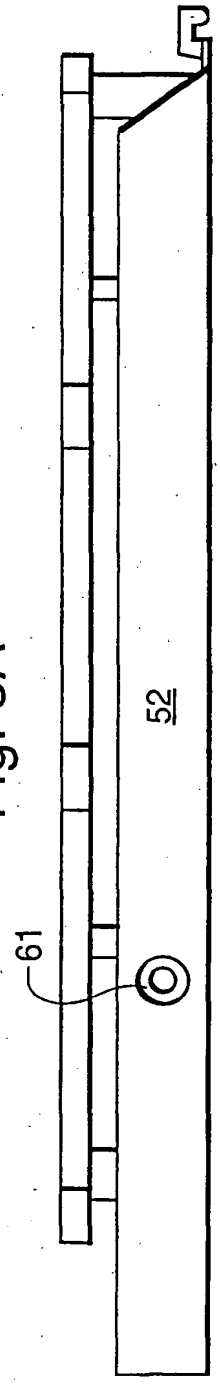

Fig. 3B

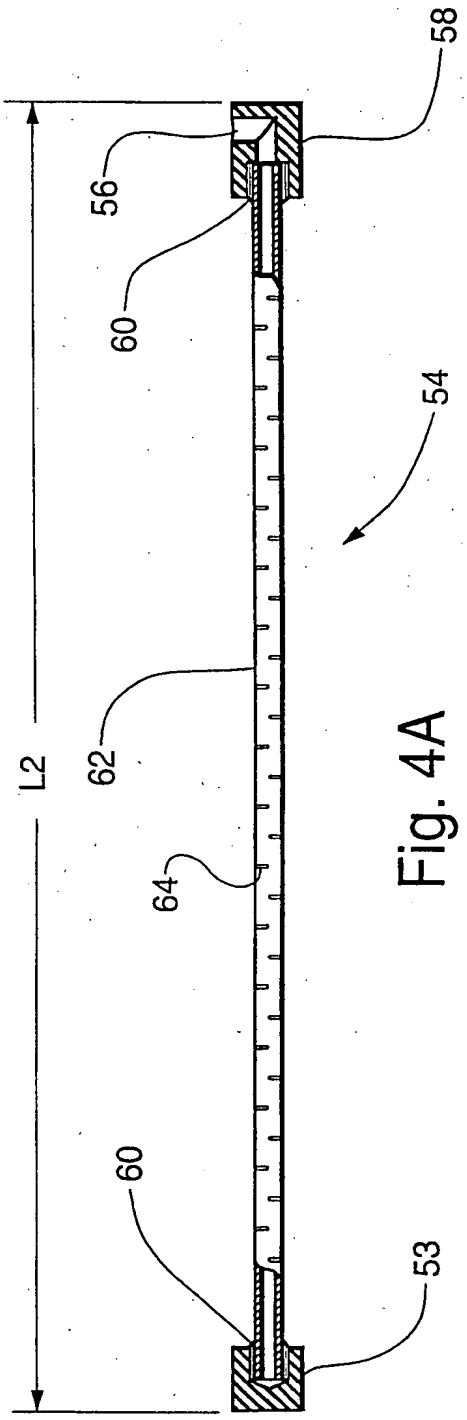

Fig. 4A

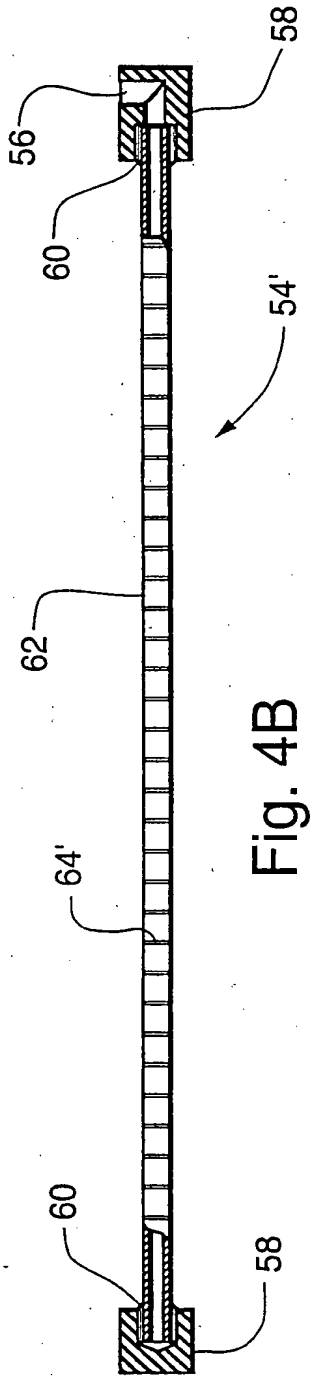

Fig. 4B

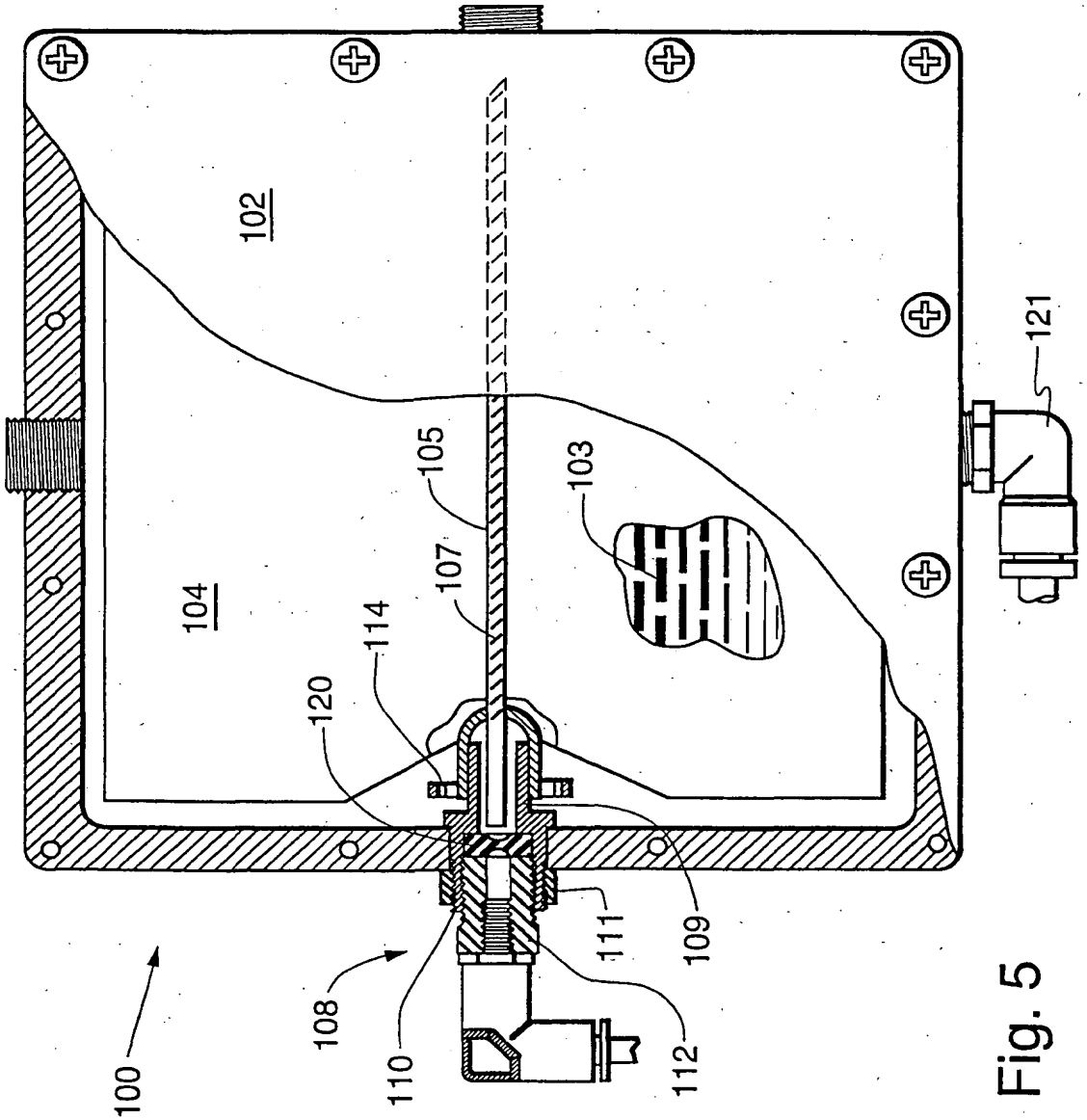

Fig. 5

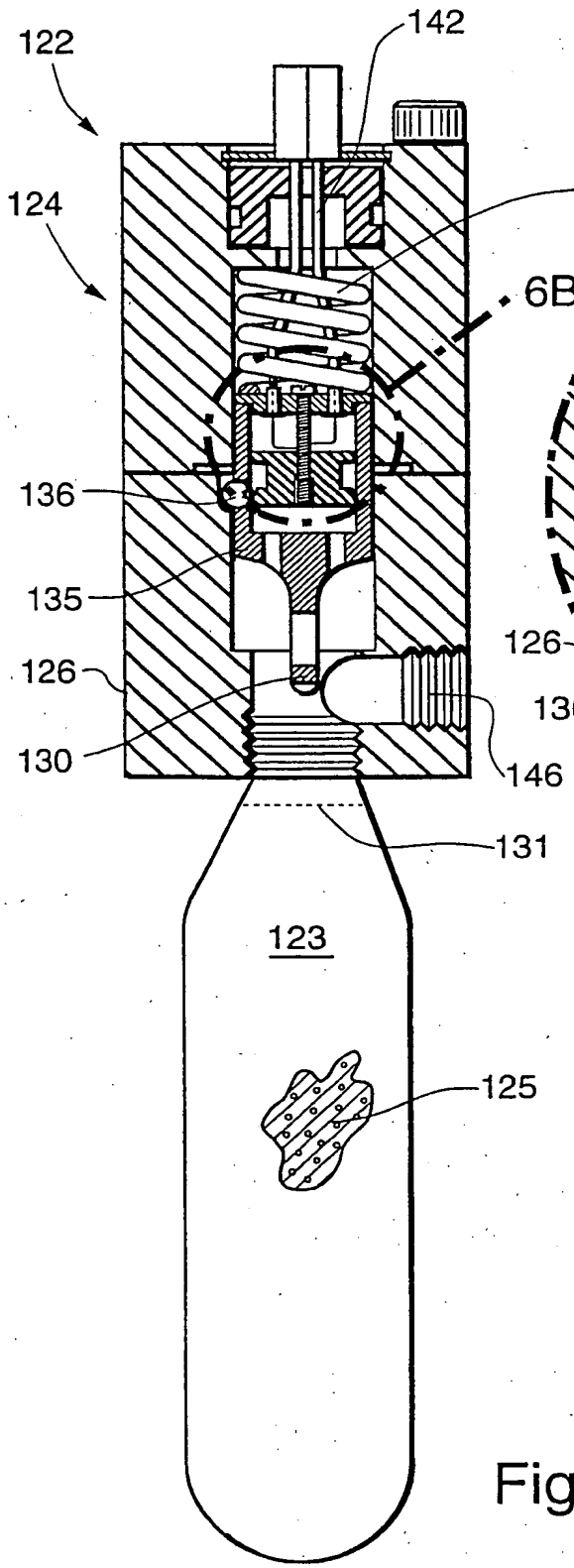
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Fig. 6A

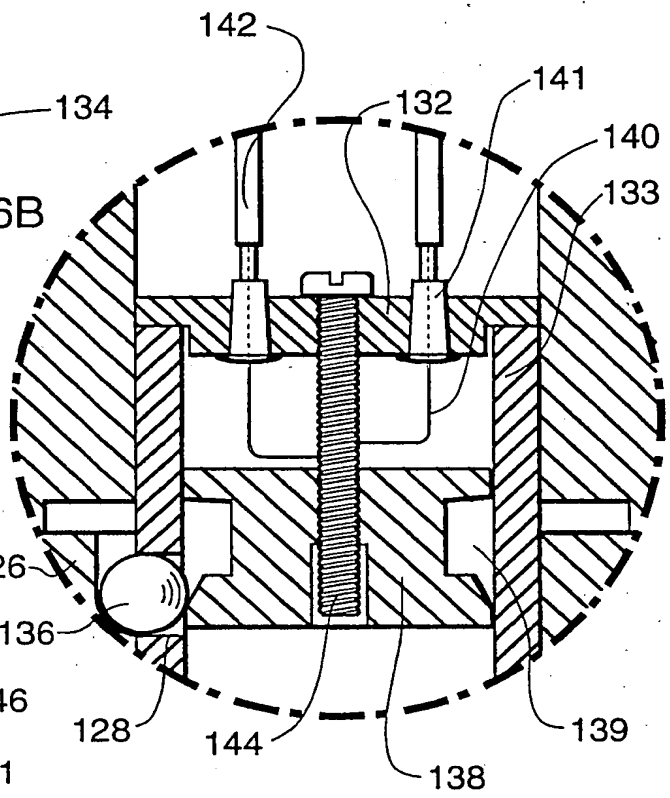
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FIG. 6B

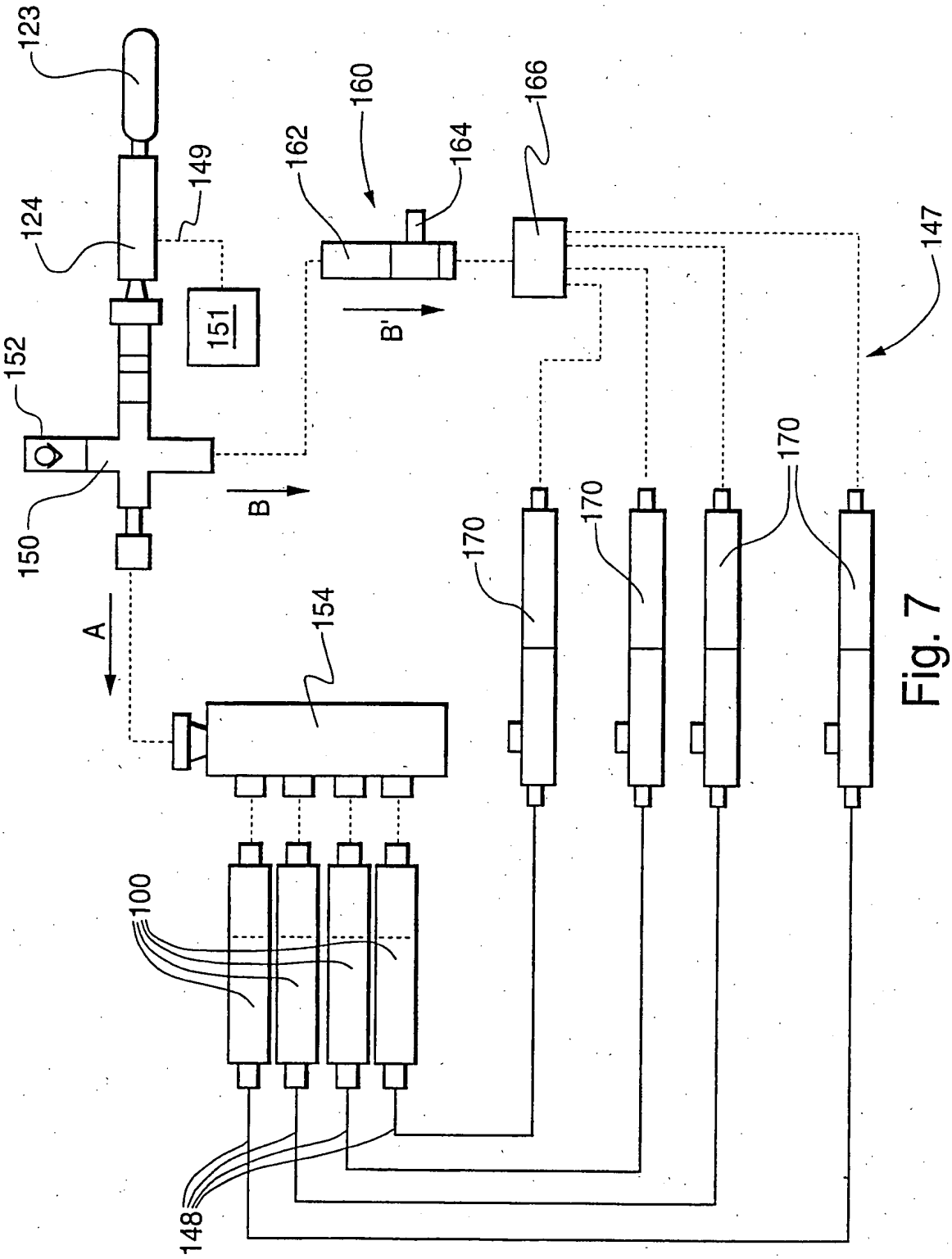
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Fig. 7

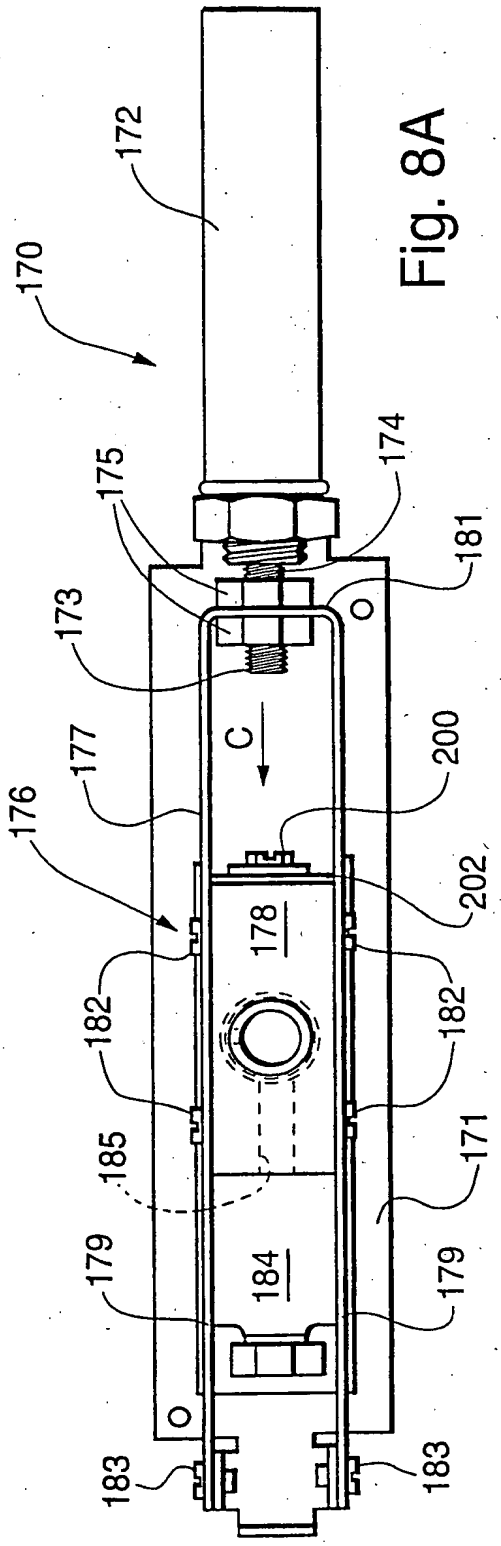
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Fig. 8A

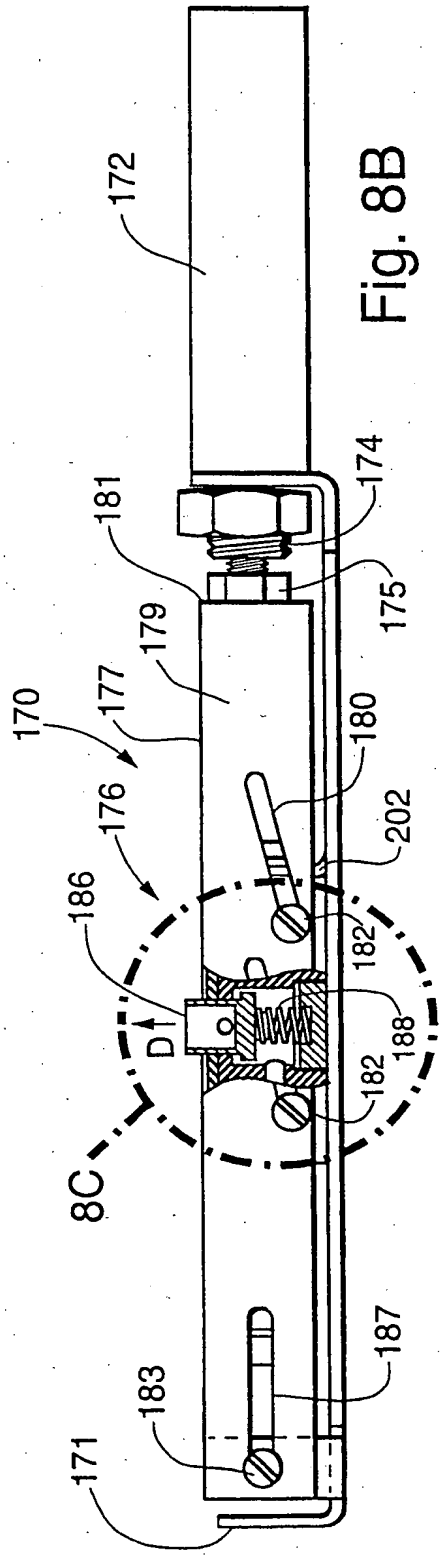
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Fig. 8B

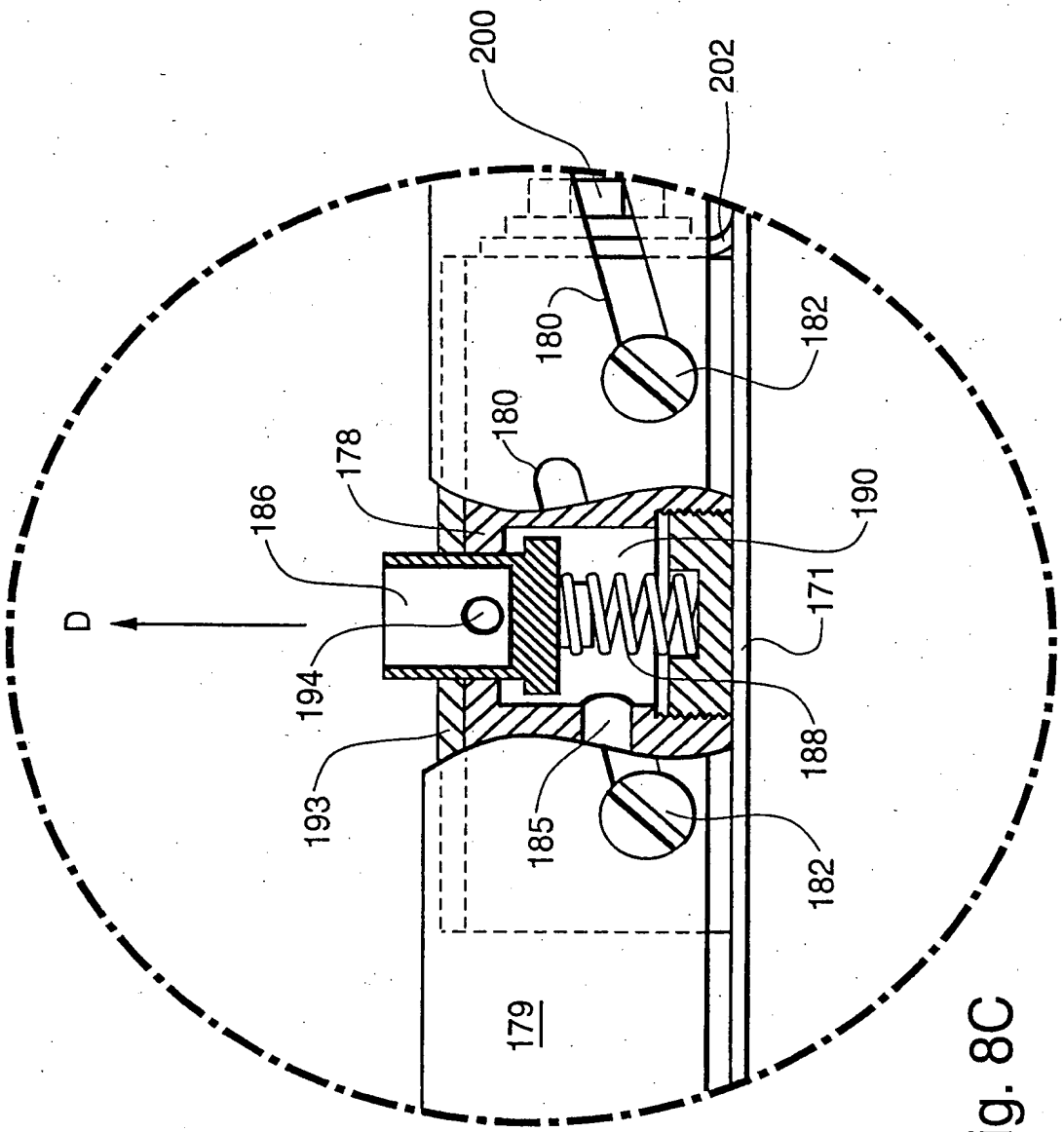

Fig. 8C

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/10613

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G06F 17/60
US CL : 235/379,380,381,382,486,487; 902/8,9,12,13,14,17,31
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 235/379,380,381,382,486,487; 902/8,9,12,13,14,17,31

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,598,793 A (LOPEZ, JR.) 04 February 1997 (04/02/97), see entire document	1-36
X	US 5,537,938 A (LOPEZ, JR.) 23 July 1996 (23/07/96), see entire document	1-36
A	US 5,410,295 A (VAN LINT) 25 April 1995 (25/04/95), see entire document	1-36

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 23 JUNE 1999	Date of mailing of the international search report 16 JUL 1999
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer MICHAEL G. LEE Telephone No. (703) 305-3503

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/10613

B. FIELDS SEARCHED
Electronic data bases consulted (Name of data base and where practicable terms used):

APS

search terms: anti(1w)theft(p)(atm or automat#### teller machine#), ink, (atm or automat### teller machine# or (cash or currency or note# or negotiable instrument))(p)dispens?, (destroy? or mark? or paint? or spray?)(p)(indelible ink or ink), nozzle#, valve#, cylinder, defacing, pneumatic cylinder